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FILM FORMING DEVICE

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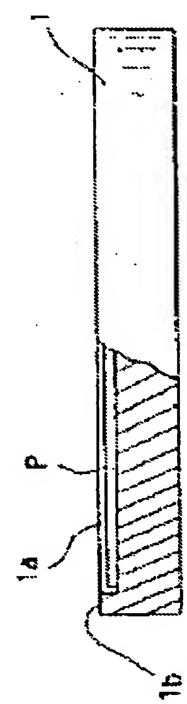
Abstract of **JP63140085**

PURPOSE:To form a thin film having a uniform thickness and is distortion-free on the surface of a plate-shaped body with a plasma CVD device by using a ceramic material having a specific coefft. of heat conduction to constitute a pedestal on which the platesphaped body such as semiconductor wafer is imposed.

CONSTITUTION:A recess 1a suitable to be imposed with the plateshaped body P such as semiconductor wafer or single crystal sapphire is formed integrally with a framing 1b in the peripheral part atop an imposing base 1. The base 1 is constituted of the ceramic material having >=20W/m.K coefft. of heat conduction, for which alumina, silicon carbide sintered body or sintered alumina nitride body is preferably used. The heating of the body P so as to have a uniform temp. distribution is thereby permitted at the time of heating the body P with the base 1. The film having a uniform thickness and properties is thus deposited on the body P.



DESCRIPTION

1. The name of the invention

Film formation equipment

2. The claims of the invention

[Claim 1]

Film formation equipment on which plate-like body such as a semiconductor wafer and single crystal sapphire is to be placed and the film is covered on the surface of said plate-like body

characterized in that the plinch for placing said plate-like body is consisting of the ceramic material having a heat conductivity of 20 W/m・K or more.

[Claim 2]

Film formation equipment according to claim 1, wherein

said ceramic material is alumina, silicone carbide type sintered body or aluminum nitride type sintered body.

3. Detailed Description of the Invention

(Industrial Field in which the Invention to be utilized)

This invention relates to the film formation equipment which forms a thin film on a necessary substrate.

(The conventional technique)

As the method of forming a thin film in necessary body surfaces such as a semiconductor wafer and an alumina-single-crystal substrate and the like, there are mainly two methods: that is, the physical vapor deposition methods (PVD) such as vacuum evaporation, sputtering, and an ion plating and the like; and the chemical vapor deposition methods (CVD) which utilizes an activated chemical reaction.

Among these, for example, the sketch of the plasma CVD

equipment as film formation equipment is shown in the Fig. 1. In this figure, on the basis of introduction of carrier gas, such as argon, oxygen, nitrogen, and ammonia, into Chamber C, high-frequency voltage is applied between a discharge electrode E and the substrate electrode S, so as to generate a plasma discharge in the chamber. In this process, the substrate electrode S has been heated by Heater H to 480 to 500 degrees C, for instance (the temperature differs with film formation materials etc.). Then, after placing the installation base D on this substrate electrode S, a plate-like body on which the film is supposed to be formed is set on the installation base D. Thereafter, an volatile metal compound is introduced therein on the condition of heating this plate-like body, so as to form the thin film on the surface of a plate-like body, on which a crystalline or an amorphous is deposited. As seen in the case of forming the film in the chemical forming-films method using the plasma CVD equipment in the above, in order to give the activation energy which promotes a chemical reaction, the plate-like body P which puts the film thereon is heated. That is, the plate-like body P is heated to an optimum temperature by installing Heater H on the substrate electrode S, and heating the installation base D. As such an installation base D, the one made of metal such as Hastelloy of a small coefficient of thermal expansion, an Inconel, and 42 alloys has been used.

(Problems which the invention tries to solve)

However, the installation base D made of the above-mentioned metal has a comparatively large coefficient of thermal expansion. Also, it has small Heat conductivity (cal・cm/cm^2・sec・℃): that is 0.036 for an Inconel and about 0.03 for a Hastelloy. For this reason, with the film formation equipment using the installation base which consists of such a metal, the temperature distribution of a plate-like body as an object to be heated placed on the installation base, heated by Heater H does not become uniform, and temperature unevenness is generated. In case the film is put on a plate-like body surface side (film formation), the physical properties of a thickness

or the film will not become uniform, and characteristics thereof become uneven.

Also, in many cases, a plate-like body with the film is washed by hydrogen fluoride, while being placed on an installation base. In that case, a metal installation base has had inconvenience because of the following:

a metal installation base has no durability since it is eroded or deformed gradually;

a metal installation base is consisting of alloy of such as Nickel or Cobalt, thus expensive; and

the weight of a metal installation base is heavy.

[Means for Solving the Problem]

Based on the above-mentioned situation, the present invention is characterized in that the installation base which consists of the sintered compact of an aluminium nitride- nature is adopted as Ceramic material which has superior heat conduction, and small thermal expansion coefficient, and had corrosion resistance and a heat-resisting property.

(Examples)

The examples of the present invention is hereafter explained in detail with Figures.

Fig. 2 shows the partial fracture surface of the installation bases 1 which constitutes the film formation equipment. On the upper surface of this installation base 1, frame 1b is formed in the circumference section in a manner that it is integrated with the installation base 1, thus forming a concave portion 1a which is suitable for laying a plate-like body P, which is an object to be heated.

In this case, frame 1b may be connected to the main body of the installation base 1 by connecting or cork screw after separately formed.

In this case, the installation base 1 is utilized by being turned (revolved), or if necessary rotated, in the condition of being placed on the rotary-table type substrate electrode S, which is similarly to the installation base D shown in Fig.1.

In this case, since Substrate electrode S, which is heated

by the heater H, has to heat the plate-like body P through the installation base 1, the substrate electrode S is required to have large heat conductivity, heat-resistance, and anti-corrosion property.

Therefore, ceramic material is listed as the material which has such a characteristic.

Then, the installation base 1 was formed by various kinds of ceramic material, and film formation characteristics (thickness variation) were measured.

Fig. 3 shows thickness variation of the installation base 1 which was constituted by an aluminium nitride with a heat conductivity of 180 to 250 W/m・k. This is the distribution of the formed film thickness (Å) on the surface of the silicone plate as a plate-like body relative to the number of the measurement. This figure shows the result that the measurement is concentrated in a narrow formation range of 4400 to 4700 Å, and the film-formation can be performed to be the original film thickness with good certainty.

Fig. 4 and Fig. 5 are the graphs of the distribution of film thickness which is performed on the basis of the same conditions as the above on the installation base 1 constituted by a silicon carbide (heat conductivity 50 to 50 W/m・k) and alumina (heat conductivity 20 to 30 W/m・k), respectively. According to these, it is understood that the film thickness shows a distribution with relatively high concentration.

Fig. 6 is the distribution of film thickness which is performed on the installation base 1 constituted by a silicon nitride (heat conductivity 10 to 20 W/m・k), and Fig. 7 is the distribution of film thickness which is performed on the installation base 1 constituted by Hastelloy (heat conductivity 7 to 16 W/m・k) which is an already existing product, respectively.

As understood from these comparative examples, when the installation base 1 which is made of material with small heat conductivity is used, distribution of film thickness is large, that is 4400 to 4700 Å. Thus, the film-formation at the original film thickness is rather difficult to be realized.

Moreover, based on the result which observed the physical properties of the film in the plate-like body surface after film formation, the film on the plate-like body had the uniform thickness regardless of center portion or the circumference section, and had the superior characteristics without generation of distortion.

Moreover, in spite of repeated washing of the plate-like body A by hydrogen fluoride on the condition of being put on the installation base 1, the installation base 1 made of ceramic material of aluminum nitride was not so much corroded nor discolored, thus it can be repeatedly used.

(Effectiveness of invention)

As mentioned above, according to the film formation equipment of the present invention, the equipment is constituted by the installation base made from ceramic material in which coefficient of thermal expansion was small, and had corrosion resistance and a heat-resisting property, thus the semiconductor device having superior physical characteristic with which film thickness is even and without distortion can be offered.

Explanation of drawing

[Brief Description of the Drawings]

Fig. 1 is a sketch of conventional film formation equipment.

Fig. 2 is a fracture surface figure of only the installation base which constitutes the film formation equipment according to the invention.

Fig. 3, Fig. 4, Fig. 5 are the graphs which shows the film formation characteristics of the examples of by the present invention, respectively.

Fig. 6 and Fig. 7 are the graphs showing film formation characteristics according to the comparative examples, respectively.

1 .... Installation base
1a .. Concave portion
P .. Plate-like body

Translation of the figure

Fig.1

Top-left corner
Carrier gas introducing system

Middle-left
Vacuum system

Top-right corner
Power source (circle in the right)
Matching box (rectangle in the left)

Bottom-right corner

Exhausting system

Fig.3 to Fig.7

Lateral axis:
Film-thickness(Å)
Longitudinal axis:
The number of the measurement

甲第7号証

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⑫公開特許公報（A）　~~昭63-140085~~

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⑤④発明の名称　成膜装置

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明　細　書

1.発明の名称

成膜装置

2.特許請求の範囲

(1) 半導体ウエハー、単結晶サファイアなどの板状体を載置し、該板状体表面に膜を被着する装置であって、上記板状体を載置する台座が20W/m・K以上の熱伝導係数をもったセラミック材から成ることを特徴とする成膜装置。

(2) 上記セラミック材がアルミナ，炭化珪素系焼結体，窒化アルミ焼結体である特許請求の範囲第1項記載の成膜装置。

3.発明の詳細な説明

（産業上の利用分野）

本発明は所要の基板上に薄膜を形成する成膜装置に関するものである。

（従来の技術）

半導体ウエハー、アルミナ単結晶基板など所要の物体表面に薄膜を形成する方法としては蒸着，スパッタリング，イオンプレーティングなどの物理的成膜法(PVD)及び活性化された化学反応を利用する化学的成膜法(CVD)の二つに大別することができる。

このうち、例えば第1図には成膜装置としてのプラズマCVD装置の概略図を示すが、これにおいてチャンバーC中にアルゴン、酸素、窒素、アンモニア等のキャリアガスの導入のもとに、放電電極Eと基板電極Sとの間に高周波電圧を印加してプラズマ放電を発生せしめるが、このうち基板電極Sは例えば480～500℃(成膜材料などによって異なる)にヒータHでもって加熱してあり、この基板電極S上に載置台Dをセットし、この載置台D上に膜を形成する板状体Pを設置した後、該板状体を上記温度に加熱状態のもとに揮発性の金属化合物を送り込み板状体Pの表面での化学反応によって結晶質又は非結晶質を析出させ板状体表面に薄膜を形成している。上記におけるプラズマCVD装置を用いた化学的成膜法において膜を形成する場合に見られるように化学反応を促進する活性エネルギーを付与するために膜を被着する板状

体P を加熱するようになっている。すなわち基板電極S にヒータH を設置し載置台D を加熱することによって板状体P を最適温度に加熱する。

このような載置台D としては熱膨脹係数の小さいハステロイ，インコネル，42 アロイなどの金属製のものを用いていた。

(発明が解決しようとする問題点)

ところが、上記金属製の載置台D は熱膨脹係数が比較的大きく、熱伝導率(cal・cm/cm²・sec・℃)がインコネルで0.036，ハステロイで0.03程度と小さい。このため、かかる金属から成る載置台を用いた成膜装置では、ヒータH の加熱による載置台上に配置した被加工物としての板状体の温度分布が一様にならず温度ムラが生じる。かかる温度ムラのある状態で板状体表面に膜を被着(成膜)した場合，膜厚や膜の物性が均一なものとならず、特性が不均一なものとなる。また膜をもった板状体を載置台に乗せたまま弗酸で洗浄する場合が多いが、その際、金属製の載置台が浸食され、次第に変形するため耐久性がなく、またニッケルやコバルトなどの合金製であるため高価であり、しかも重量が大きいなどの不都合があった。

(問題点を解決するための手段)

上記事情に鑑みて、熱伝導にすぐれ、熱膨脹係数が小さく、かつ耐蝕性，耐熱性をもったセラミック材から成る載置台を具備せしめたことを特徴とする。

(実施例)

以下、図により本発明実施例を詳述する。

第2 図は成膜装置を構成する載置台1 の一部破面を示し、この載置台1 の上面には被加工物体である板状体P を載置するに適するように凹部1aを成すべく周辺部に枠取り1bが一体的に形成してある。

この場合枠取り1bは載置台1 の本体とは別途に作成しておいたものを本体に接合したり、螺着固定してもよい。

ところで、載置台1 は第1 図に示した載置台D と同様の回転テーブル型式の基板電極S 上に載せられた状態にて回転(公転)し、また必要に応じて自転するようにして使用されるが、この際基板電極S はヒータH によって加熱され、載置台1 を介して板状体P を加熱する必要があるため、まず、熱伝導率が大きく、耐熱，耐蝕性の大きいことが要求される。

したがって、このような性質を有している材質としてセラミック材があげられる。そこで各種のセラミック材でもって載置台1 を形成し、成膜特性(膜厚バラツキ)を測定した。

第3 図は熱伝導率180 ～250W/m・k の窒化アルミニウムで載置台1 を構成したものの膜厚バラツキを示し、測定個数に対する板状体としてのシリコン板表面に成膜厚(Å)の分布であって、4400～4700Åの狭い成膜範囲に集中しており、初期の膜厚に確度よく成膜することができる。第4 図，第5 図にはそれぞれ炭化珪素(熱伝導率50～50W/m・k)，アルミナ(熱伝導率20～30W/m・k)で構成した載置台1 上にて上記と同様の条件のもとに成膜を行った成膜厚の分布をグラフ化したもので、これらも比較的集中度の高い膜厚が被着されていることが判る。

また第6 図は窒化珪素(熱伝導率10～20W/m・k)，第7 図は在来品であるハステロイ(熱伝導率7 ～16W/m・k)からそれぞれ成る載置台1 にて成膜した場合の膜厚の分布を示し、これら比較例から判るように熱伝導率の小さい材質から成る載置台を用いた場合の膜厚は4400～4700Åまで分布が広く、初期の厚さの成膜を行うことがかなり困難であった。

また、成膜後の板状体表面における膜の物性を観察した結果、板状体の中心部，周辺部ともに均一な膜厚を有し、歪の発生もなくすぐれた特性を有していた。

さらに成膜した板状体を載置台1 に乗せたまま弗酸による洗浄をくり返したが本発明実施例による窒化アルミニウム，炭化珪素，アルミナの各セラミック材製の載置台1 は比較的浸蝕されたり、変色することなくくり返し使用可能であった。

(発明の効果)

叙上のように本発明成膜装置によれば熱伝導にすぐれ，熱膨脹係数が小さく，かつ耐蝕，耐熱性

をもったセラミック材製の載置台で構成したことから、膜厚が均一で、歪のないすぐれた物性をもった薄膜を備えた半導体素子等を提供することができる。

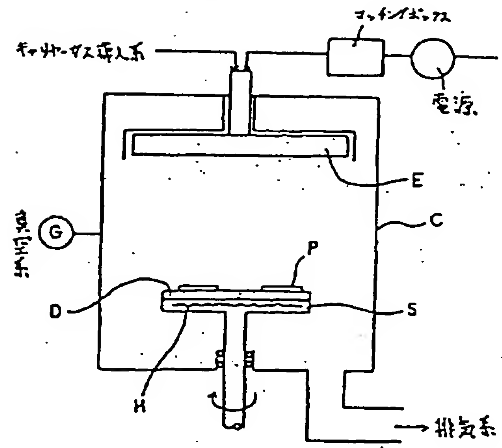
4.図面の簡単な説明

第1図は在来の成膜装置の概略図、第2図は本発明成膜装置を構成する載置台のみの破断面図、第3図，第4図，第5図はそれぞれ本発明実施例による成膜特性を示すグラフ、第6図及び第7図はともに比較例による成膜特性を示すグラフである。

1・・載置台
1a・・凹部
P・・板状体

特許出願人
京セラ株式会社

第 1 図



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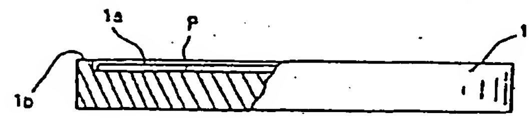
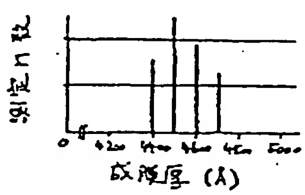
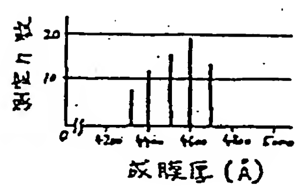


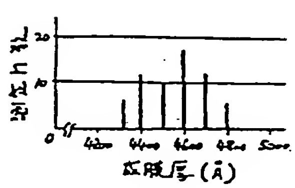
第 3 図



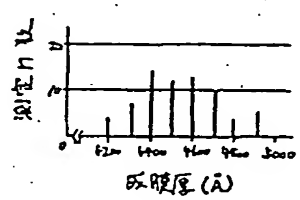
第 4 図



第 5 図



第 6 図



第 7 図